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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 :		(11) International Publication Number:	WO 91/17510
G06F 15/30, 15/42	A1	(43) International Publication Date:	14 November 1991 (14.11.91)

(21) International Application Number: PCT/US91/02775

(22) International Filing Date: 23 April 1991 (23.04.91)

(30) Priority data:
517,257 1 May 1990 (01.05.90) US

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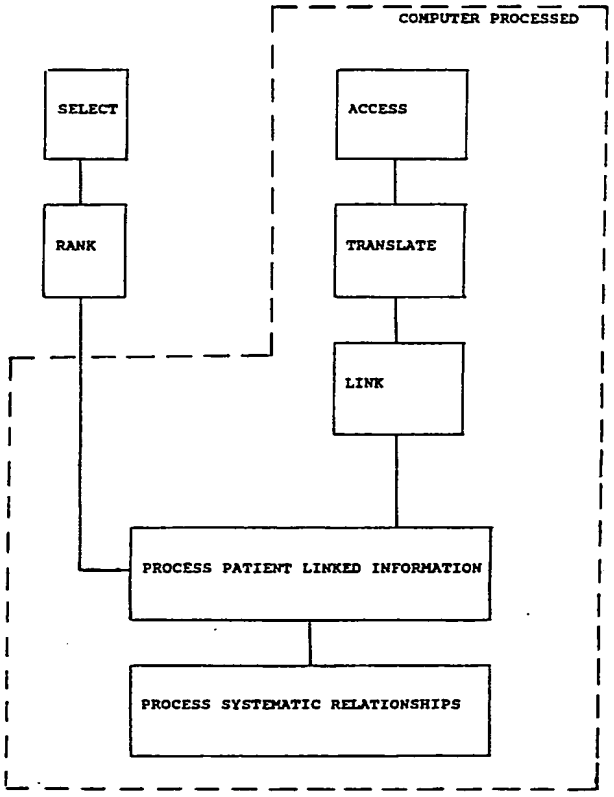
(81) Designated States: AT (European patent), BE (European patent), CA, CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB (European patent), GR (European patent), IT (European patent), JP, LU (European patent), NL (European patent), SE (European patent).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: HEALTH CARE SERVICES COMPARISON PROCESSING

(57) Abstract

Health care services information from outpatient and impatient claims data bases are computer processed relative to selected clinical variables, which include age, gender, and diagnoses, and preferably also include comorbidity and use of some procedures. These variables are ranked into orders of clinical complexity; and, primarily by means of regression analysis, the extent of systematic relationships of the ranked clinical complexity variables are determined relative to the costs (and preferably also to the utilization of procedures and indicia of quality) of health care services rendered to a patient population. In this process, the available data on the health care experience of the patients is linked to each patient so that information abut the state of the health of each patient can be systematically related to the clinical complexity variables. Determination of the systematic relationships of the services rendered to the clinical complexity variables then allows comparisons of cost (and preferably also of utilization of procedures and indicia of quality). The comparisons are made meaningfully equivalent by adjusting for the clinical complexity of the patients receiving the services in question. This allows a realistic comparison of the efficiency of health care services from different providers.



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TITLE

HEALTH CARE SERVICES COMPARISON PROCESSING

BACKGROUND

Direct comparisons of cost, quality, or utilization of procedures between different providers of health care services has generally been unattainable. There has been no way of realistically determining the true needs for the services rendered, because there has been no way of knowing the comparative health of the different patients to whom the services are rendered. For example, if the services of one physician to one group of patients cost more than the average cost of similar services to similar patients by a larger group of similar physicians, the doctor rendering the more expensive services can argue that the recipient patients have more complex health problems that are more difficult or more expensive to treat. There has been no reliable way to determine whether such an assertion is valid; and for lack of a truly equivalent comparison basis, there has been no reliable way for group purchasers of health care services to distinguish between efficient and inefficient providers of health care services.

Diagnostic related groups (DRGs) have been instituted for Medicare services as a method of making averaged payments (rather than fee-for-service payments) to different providers of health care services. DRGs have not successfully met the need for valid inter-provider comparisons, however, because they apply only to inpatient data, apply only to hospital payments, and involve many clinically unrelated diagnosis groupings. There has been much controversy with DRGs and with the comparisons derived from them.

Other comparison attempts have involved reviewing patient charts from hospital admissions to extract additional information about the health care needs and services involved, but this has been very laborious and expensive. It is not a practical solution to the need for consistently and inexpensively comparing the vast quantities of health care services being continually rendered.

SUMMARY OF THE INVENTION

We have discovered a better way of comparing health care services from different providers, and our method uses available health claims data so that the comparisons can be done inexpensively by computer. Our method uses all the available health care experience from both inpatient claims data and outpatient claims data so as to deal with everything relevant about the health of the patients in a population. All the available health care experience information is then translated into standard input files and associated with each specific patient to reveal as much as possible about the state of each patient's health.

Separately from the computer processing, we select clinical variables available in the data bases for age, gender, diagnoses, and preferably comorbidity and utilization of selected procedures indicative of a patient's health status. We then rank these clinical variables into orders of clinical complexity. Then we computer process the health care experience information linked to each of the patients to determine the extent of systematic relationships of the ranked clinical complexity variables to the cost and preferably also to utilization of procedures and indicia of quality of health care services rendered to patients. Once the systematic relationships of the ranked clinical complexity variables to the health care services are known, we computer process the systematic relationships to make equivalent comparisons. We can make each comparison truly equivalent by adjusting for the clinical complexity of the patients receiving the services being compared; and subject to the equivalency adjustments based on clinical complexity, we can compare equivalent costs, utilization of procedures, and indicia of quality of health care services rendered to different groups of patients by different providers.

The use of ranked clinical complexity variables, and the determination of systematic relationships of those clinical complexity variables with the health care services rendered to the patients affords us a statistically sound method of making meaningfully equivalent comparisons between

different services rendered based on the clinical complexity of the patients involved. Comparisons made this way afford significant additional information to group purchasers of health care services; and as the efficiency of health care services improves from further purchases based on the equivalency comparison information, this tends to alter the cost, utilization of procedures, and indicia of quality of the services being rendered. This can warrant a new analysis of the systematic relationships and new equivalency comparisons, for continually improving the efficiency of health care services. At the same time, we continually refine our rankings of orders of clinical complexity for the clinical variables available from the data bases. The result is to make group purchasers of health care services much more informed than has previously been possible.

DRAWING

The drawing is a schematic diagram of preferred steps in our method of processing health care service information to yield meaningful comparisons according to the invention.

The labels on each of the boxes in the schematic flow diagram refer to information as follows:

SELECT refers to selecting clinical variables for age, gender, diagnoses, comorbidity and procedures;

RANK refers to ranking clinical variables into orders of clinical complexity;

ACCESS refers to outpatient claims data and inpatient claims data for patient population;

TRANSLATE refers to translating all available data into standard input files;

LINK refers to linking all health care experience information to each patient of patient population;

PROCESS PATIENT LINKED INFORMATION refers to determining the extent of systematic relationships of ranked clinical complexity variables to cost, utilization of procedures, and indicia of quality of health care services rendered to patients; and

PROCESS SYSTEMATIC RELATIONSHIPS refers to comparing equivalent cost, equivalent utilization of procedures, equivalent indicia of quality of health care services rendered to different groups of patients by different providers.

DETAILED DESCRIPTION

Our invention involves computer processing of health care experience data to provide more useful information to group purchasers of health care. The source of the data to be processed is generally claims records of health care experience covered by a health care insurance plan, an employee health plan, a health maintenance organization, or some other organization that pays for health care on a group basis. The data involved is generally in the form of claims information that have been entered into a computer, in the course of paying the claims; and the data represents the health care experience and related information on a population of patients. Although the available data has different structural and organizational forms, common inputs generally exist among the available data bases, because of the conventions normally used in the payment processing of health insurance claims. The common inputs include an identifier for the patient being treated, and an identifier for the

provider of the health care service, the age and gender of the patient, a standardized number indicating the diagnosis, another standardized number indicating the procedure performed, and the date and location of the service. From this data, which is common to health care insurance records, we can derive considerable information having comparative value.

The specialty of a physician rendering a service is not normally available directly from the claims tapes data bases, yet we prefer to determine physician specialties directly from the available data. To do this, we identify from other sources the specialties of a few representative physicians performing large amounts of services to the patient population. We then determine from the claims data from these physicians what procedures characterize their services to patients. Other physicians performing the same procedures are then classified with the predetermined specialty for such services. This way of determining physician specialties is advantageous because it is not labor intensive and yet still appropriately groups similar practitioners (e.g., neurosurgeons are grouped with neurosurgeons rather than with pediatricians).

Our comparison process uses all the available health experience information, to take advantage of whatever can be known about the health of the patient population represented by the data bases. Many other health care information processing systems use only inpatient data, which tends to represent the more expensive health care experiences. Using only inpatient data, or using the available data on an episode of illness basis, as many previous health care information systems do, makes meaningful comparisons between the health care services of different providers unattainable.

Our method uses outpatient claims data, as well as inpatient claims data, so that everything available about the health experiences of the patients involved is computer accessible and is considered in our process. This information is associated or linked with each patient of the population, so as to reveal as much as possible about the

state of the health of the patients involved. Previously known health care service information processing systems have not considered outpatient claims data and have not linked the available data to the patients involved. Because previous systems have generally looked only at episodes of illness (admissions to a hospital), rather than to the total health care experience of the patients involved, they could examine only information about a patient during the time of a hospital admission. This left large amounts of data on health care services inaccessible to any analysis of meaningful equivalents in the efficiency of the services being rendered.

Our method also relies on available data from claims involving health care experience, without requiring laborious examination of patient charts or other information that is not immediately accessible by computer. The costly and time-consuming chart review used to augment inpatient data for analyzing illness complexity is too prohibitively cumbersome to apply to outpatient records that are relatively numerous and dispersed. In contrast, our health care information processing system can inexpensively and efficiently take advantage of outpatient data in processing health care information to make meaningfully equivalent comparisons.

Beginning at the upper right of the schematic diagram of the drawing, our process *ACCESSES* both the outpatient claims data and the inpatient claims data for a patient population covered by available data bases. All this information is then *TRANSLATED* into standard input files so that it can all be entered consistently for computer processing according to our method. Also, all the available health care experience information is *LINKED* to each patient of the patient population so as to reveal as much knowledge as the data base permits about the state of health of each of the patients in the population.

Before our computer processing begins, we *SELECT* a set of clinical variables that we deem useful in evaluating the health of the patients in the population. The clinical variables we select involve information that is available in the data bases, and our selections for clinical variables

include age, gender, and diagnoses for all the available health care experience information for each patient. We also preferably select as clinical variables comorbidity, meaning the existence of a significant secondary diagnosis present in a single patient having another primary diagnosis, such that the secondary diagnosis may be reasonably expected to increase the overall treatment required for the patient. Not all combinations of diagnoses represent a comorbid status, and we have selected those that are clinically reasonable. Examples include hypertension and diabetes, a previous heart attack and diseases of the heart valves, obesity and pneumonia, and many others.

Another clinical variable we prefer is procedures that a patient has undergone that are especially revealing about the patient's health state. Examples of highly relevant procedures include use of kidney dialysis equipment, breathing assistance equipment, or chemotherapy. The procedures we select are unlikely to be used unless a patient truly requires them, so that use of the selected procedures will present a high clinical likelihood of adding to the treatment required for virtually all diagnoses. Inclusion of selected procedures also seeks to ensure that information about significant health problems indicated by the procedures is included in a patient's history in a fail-safe manner. Many medical procedures do not necessarily indicate a clinically complex state of health for the patient who has undergone the procedure, but the procedures we preferably select, such as those mentioned above, do reveal that the patient who has undergone them has a clinically more complex health state.

After selecting clinical variables that can reveal meaningful information about the health state of the patients represented by the available data bases, we *RANK* the clinical variables into orders of clinical complexity. The selection and ranking of the variables involve some clinical experience and judgment; and in the ranking process, we consider acute diseases, chronic diseases, mental health, pregnancy, comorbidity, and other factors. It is possible to rank the

clinical variables into any number of different orders of clinical complexity, but we prefer about four to five orders of clinical complexity ranging from good health to a patient with highly complex health problems. The rationale for such ordering is that clinicians and health service purchasers understand distinctions between orders such as NONE, MILD, MODERATE, SEVERE, so that such orders facilitate communication and analysis. We consider pregnancy as a clinical variable in our method, and for orders of pregnancy risk, we use rankings ordered as NONE, NOT CARRIED TO TERM, MILD, MODERATE, SEVERE.

Once we have the selected clinical variables ranked into orders of clinical complexity and have the available health care experience information linked to patients so that it is computer accessible on a patient basis, we *COMPUTER PROCESS* the health care experience information from the data bases relative to the ranked orders of clinical complexity to determine the degree to which the cost of the health care services rendered systematically relates to the ranked variables of clinical complexity. To do this, we prefer a regression analysis, such as explained in Principals of Econometrics by Henri Theil, New York, Wiley, 1971.

The most important information from the health care experience data to be systematically related to the clinical complexity variables is the cost of health care services provided to the patients, because purchasers of health care services are very much interested in the cost. Our regression analysis of the patient-linked information thus determines the extent of *SYSTEMATIC RELATIONSHIPS* of cost to the clinical complexity variables.

Our method can go further, however, and can determine the extent of other systematic relationships with our clinical complexity variables. These preferably include utilization of procedures and indicia of quality. The utilization of procedures includes such things as blood tests, other laboratory tests, X-rays, tomography, operational procedures, office visits, and others. Overall utilization of procedures can be expected to increase as clinical complexity

increases. Our methodology allows us to quantify that increase and then to analyze the associated distribution of utilization practices among individual providers in a meaningfully equivalent fashion. Our regression analysis of the available health experience data relative to our clinical complexity variables thus enables us to determine the extent to which various procedures relate to the clinical complexity of the health of the patients in the data base population.

Quality of health care services has long been difficult to determine, but there are some indicia that are reliable indicators of quality, and we preferably use the ones we judge to be meaningful. These can include outcomes such as mortality or complications following procedures. Some complications or poor outcomes may be expected to increase with an increase in clinical complexity. Our methodology allows us to quantify that increase. We can then proceed to compare the results of medical practice among individual providers in a meaningfully equivalent fashion. This is possible because regression analysis in our computer processing method can determine the extent to which such indicia of quality of health care services relate to the clinical complexity of the patients involved.

Once we determine the systematic relationships to the clinical complexity variables of the cost and other aspects of the health care services rendered, such as utilization of procedures and indicia of quality, we can then make meaningfully equivalent comparisons between health care services rendered to the patient population by different providers. These comparisons can include the health care services of one physician, such as an internist, compared with the health care services rendered to the patient population by all the internists involved; the health care services of one health maintenance organization compared with the health care services rendered to the whole patient population; and other comparisons. Such comparisons can include comparing a single internist's actual experience with his patient population for a given time period with the average

experience of the "average" internist who deals with the same age, gender, and case mix complexity of patients.

Our determination of the systematic relationships of clinical complexity variables to costs of health care services rendered (and preferably also with procedure utilizations and indicia of quality) allows us to make meaningfully equivalent comparisons that are adjusted to account for the varying clinical complexity of the patients receiving the services. Previously, the more extensive health care rendered to more clinically complex patients of one physician made relatively invalid comparisons with the less clinically complex average of the patients of all otherwise similar physicians. The same would also be true of other providers of health care services such as HMO's, hospitals, Allied Health Professionals, etc. Adjusting for the clinical complexity of the patient population being served allows more meaningfully equivalent comparisons between similar groups of providers having varying sizes and complexities of patient groups.

The meaningfully equivalent comparisons that our process produces, using patient-related data and clinical complexity variables for the patients involved, can supply useful information on the efficiency of different health care services. This is especially valuable for organizations that purchase health care services on a group basis. Once the comparative efficiencies are known, the health care purchasers can choose the more efficient providers, and inefficient providers, when confronted with the comparative evidence, can take steps to become more efficient. Payment adjustments, such as compensation rates for physicians or HMO's, previously adjusted only for patient age and gender, can be made more equitable by use of our method.

The changes that are expected in efficiencies of health care services purchased in the light of information developed by our method may gradually alter the systematic relationships between the services and the clinical complexity variables. This can warrant a reanalysis of the systematic relationships to adjust those relationships to

reflect altered experience with the efficiency of the health care services being rendered. A new regression analysis refining the systematic relationships of the services to the clinical complexity variables may yield new information about comparative efficiencies of different providers. This in turn can further improve efficiency until all providers of health care services are working at comparable efficiencies. This should yield the best health care for the money spent, while keeping the purchasers well informed about the efficiencies of the services they buy.

Experience with the application of our method of processing health care experience information is also expected to produce refinements in the ranking of clinical variables into orders of clinical complexity. The ranking of the clinical complexity variables is expected to be an ongoing process, not only to refine the practice of our invention, but to take into account new diseases, procedures, diagnoses, and indicia of quality.

WE CLAIM:

1. A method of deriving health care information from existing data bases, said method comprising:

a. selecting a set of variables present in said data bases, said variables including age, gender, and diagnoses of patients;

b. ranking said variables into a plurality of orders of clinical complexity;

c. computer processing said data bases to associate with each respective patient of a population of patients represented by said data bases information available from said data bases on health care experience of each of said patients, including age, gender, diagnoses, and cost of health care services rendered to each of said patients;

d. computer processing said health care experience information of said patients relative to said ranked variables of clinical complexity to determine the degree to which the cost of health care services rendered to said patients systematically relates to said ranked variables of clinical complexity; and

e. computer processing the systematic relationships of said ranked variables of clinical complexity and to said cost of health care services to compare health care service costs that are made equivalent by adjusting for the clinical complexity of the patients to whom the services were rendered, said services compared for equivalent cost being rendered to different groups of said patient population by different providers of health care services.

2. The method of claim 1 wherein said health care experience of said patients includes utilization of health care services; said computer processing of said health care experience information relative to said clinical complexity variables also determines the degree to which the utilization

of health care services rendered to said patients systematically relates to said clinical complexity variables; and said computer processing of said systematic relationships compares utilizations of health care services that are made equivalent by adjustment for the clinical complexity of the patients receiving the services, said services compared for equivalent utilizations being rendered to different groups of said patient population by different providers of health care services.

3. The method of claim 1 wherein said health care experience of said patients includes indicia of quality of said health care services rendered; said computer processing of said health care experience information relative to said clinical complexity variables also determines the degree to which said indicia of quality of health care services rendered to said patients systematically relates to said clinical complexity variables; and said computer processing of said systematic relationships also compares said indicia of quality of health care services made equivalent by adjustment for the clinical complexity of the patients involved, said services compared for equivalent indicia of quality being rendered to different groups of said patient population by different providers of health care services.

4. The method of claim 1 wherein said variables include comorbidity.

5. The method of claim 1 wherein said variables include previously experienced procedures indicative of patient health.

6. The method of claim 1 wherein said data bases include outpatient claims data and inpatient claims data.

7. The method of claim 1 including repeating computer processing of said health care experience information relative to said clinical complexity variables after using said equivalent cost comparisons to affect purchases of health care treatment.

8. A method of increasing the information available to group purchasers of health care services, said method comprising:

a. computer processing available data bases to associate with each patient of a patient population the data base health care experience information relevant to each respective patient so that said health care experience information is computer accessible on a patient basis;

b. selecting information variables present in said health care experience information, said variables including age, gender, and diagnoses of said patients;

c. ranking said variables into orders of clinical complexity;

d. computer processing the patient-related health care experience information to determine the degree to which said clinical complexity variables systematically relate to experienced cost of rendering health care services to said respective patients; and

e. computer processing the systematic relationships of health care costs with said clinical complexity variables to compare health care services costs made equivalent by adjustment for the clinical complexity of the patients involved, said services compared for equivalent costs being rendered to different groups of said patient population.

9. The method of claim 8 wherein said variables include comorbidity.

10. The method of claim 8 wherein said variables include previously experienced procedures indicative of patient health.

11. The method of claim 8 wherein said computer processing of said patient-related information also determines the degree to which said clinical complexity variables systematically relate to utilization of health care services rendered to said groups of patients, and said computer processing of said systematic relationships includes a comparison of health

care services utilizations made equivalent by adjustment for the clinical complexity of the patients involved, said services compared for equivalent utilizations being rendered to different groups of said patient population.

12. The method of claim 8 wherein said computer processing of said patient-related information also determines the degree to which said clinical complexity variables systematically relate to indicia of quality of health care services rendered to said groups of patients, and said computer processing of said systematic relationships also compares indicia of quality of health care services made equivalent by adjustment for the clinical complexity of the patients involved, said services compared for equivalent indicia of quality being rendered to different groups of said patient population.

13. The method of claim 8 including repeating said computer processing of said patient-related information relative to said clinical complexity variables after using said equivalent cost comparisons in purchasing health care services.

14. The method of claim 8 wherein said groups of patients include groups receiving health care services from specific providers of health care services.

15. In a method of comparing the cost of services from one provider of health care services with the average cost of health care services from other providers of similar health care services rendered to a patient population, the improvement comprising:

a. computer processing outpatient claims data and inpatient claims data to link health care experience information available from said claims data with each respective patient of said patient population;

b. selecting predetermined variables available from said claims data for age, gender, and diagnoses of said patients;

c. ranking said variables into a plurality of orders of clinical complexity;

d. computer processing the patient-linked health care experience information relative to said clinical complexity variables to determine the degree to which the cost of health care services rendered to respective patients systematically relates to said clinical complexity variables; and

e. computer processing the systematic relationships of health care costs with said clinical complexity variables for comparing health care service costs that are made equivalent by adjustment for the clinical complexity of the patients involved, said equivalent cost comparisons being made between health care services from one provider to one subgroup of said patient population and health care services from similar providers to another subgroup of said patient population.

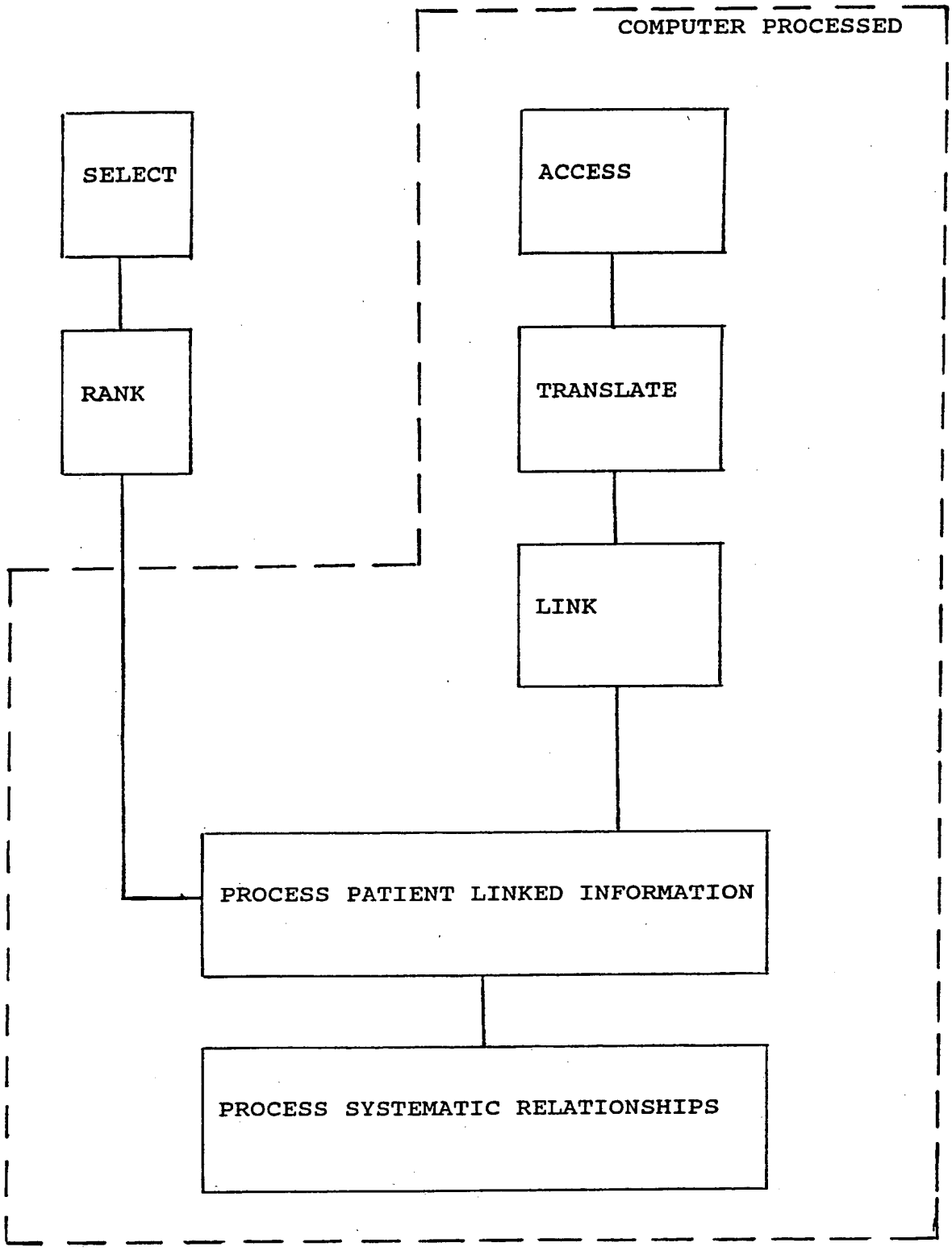
16. The improvement of claim 15 wherein said predetermined variables include comorbidity.

17. The improvement of claim 15 wherein said predetermined variables include experienced procedures indicative of patent health.

18. The improvement of claim 15 wherein said computer processing of said patient-linked health care information relative to said clinical complexity variables also determines the degree to which utilization of health care services rendered to respective patients systematically relates to said clinical complexity variables, and said computer processing of said systematic relationships also compares health care services utilizations made equivalent by adjustment for the clinical complexity of the patients involved, said equivalent utilization comparisons being made between one provider of health care services and similar providers of health care services.

19. The improvement of claim 15 wherein said computer processing of said patient-linked information relative to said clinical complexity variables also determines the degree to which indicia of quality of health care services rendered to respective patients systematically relates to said clinical complexity variables, and said computer processing of said systematic relationships also compares indicia of quality of health care services made equivalent by adjustment for the clinical complexity of the patients involved, said equivalent quality indicia comparisons being made between services rendered to different groups of said patients.

20. The improvement of claim 15 including repeating said computer processing of said patient-linked information relative to said clinical complexity variables after using said equivalent cost comparisons in purchasing health care services.



SUBSTITUTE SHEET

INTERNATIONAL SEARCH REPORT

International Application No PCT/US 91/02775

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC[5]: G 06 F 15/30, G 06 F 15/42

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC[5]	G 06 F 15/21, 15/22, 15/30, 15/42

Documentation Searched other than Minimum Documentation to the Extent that such Documents are included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [10]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
A	US, A, 4667292 (W.C. MOHLENBROCK et al.) 19 May 1987 see column 1, lines 36-52; column 2, lines 19-54; column 2, lines 59-66; column 3, lines 3-54; column 4, lines 48-51; column 6, lines 15-62; column 7, lines 15-30; column 9, lines 3-25; column 10, lines 1-16; column 10, lines 45-50; column 13, lines 3-9 --	1-20
A	Proceedings of the Seventh Annual Conf. of the IEEE/Engineering in Medicine and Biology Society, Chicago, US, 27-30 September 1985, IEEE, (New York, US) J.D. Sullivan: "The design of a hospital information tracking system", pages 1287-1291 see page 8, column 2, lines 15-41; page 1288, column 2, lines 15-48; ./.	1,5,6,10, 13,15

* Special categories of cited documents: [10]

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
7th August 1991	27.09.91
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	Alfredo Prein

Form PCT/ISA/210 (second sheet) (January 1985)

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages	Relevant to Claim No.
	page 1289, column 2, lines 8-25; page 1289, column 2, lines 39-45 --	
A	Japan Telecom. Review, vol. 22, no. 1, January 1980, (Tokyo, JP), J.-I. Sugiura et al.: "Shared hospital information system - Electronic data processing in hospital", pages 53-61 see page 54, column 2, lines 5-11; page 53, table 1	1,5,6,10,13, 15

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. US 9102775 SA 47293

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 18/09/91
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 4667292	19-05-87	None	

EPO FORM P0479

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82